REMARKS

The specification stands objected to for a typographical error in the equation at page 19, line 21 and page 19, line 25. The page 19 of the specification has been amended pursuant to the Examiner's remarks. A separate amended copy and a separate clean copy of this page 19 is attached. The requirements of 37 CFR 1.121 have been met.

The Examiner has objected to the drawings with respect to the recitation of claim 7 regarding the language: "covering by a contacting strip". Claim 7 is being amended herein to amend this language. The language now recites: "...modulation photogates immediately adjoining the accumulation gates..., on a side towards the accumulation gates, include a contacting strip of high conductivity and of no or very low transparency." The opaque-like strip is a part of the modulation photogates. This language is a characterization of the disclosed element. The structure is shown in Fig. 1 and is decribed on page 11, lines 25-30, in connection therewith as well as in other areas of the specification. This amendment to claim 7, should moot this Examiner's objection to the drawings.

The Examiner has objected to the drawings with respect to the recitation of claim 12, regarding an "octahedron shape". An "octahedron" is a polyhedron having eight faces, each of which is an equilateral triangle. *McGraw Hill Dictionary of Scientific and Technical Terms* (Sixth Edition) at page 1461. It is long and widely accepted law that the originally filed claim language is a part of the disclosure. The original language of claim 12 recited the structure of Figs. 8-10 could have " cut-off corners that form an octahedron shape" out of the four pixel unit structure. This structure was originally disclosed and available for applicant to add an additional drawing showing same. Applicant believes his specification and drawings show his invention not to be limited to only the precise shape(s) illustrated in his figures. Applicant further believes his claim language (claims 1-23) as originally filed, and as amended herein (claims 1-26) do not limit the shape of his structure to only that illustrated in his figures, and therefore do not preclude other equivalent shapes including octahedron, i.e. applicant's square with the outer edges re-shaped.

Applicant's claims are intended to cover all modifications that provide equivalents to the illustrated structure.

Claim 12 has been amended herein to delete the recitation of the octahedron shape without prejudice to any reasonable interpretation of applicant's claim language. This amendment should now moot the Examiner's objection to the drawings based upon the language of claim 12.

The Commissioner, as of October 8, 2002, had received substitute formal drawings for Figs. 1, 10-12. The Examiner has approved the amendments to Figs. 1, 10-12 and the substitute formal drawings. However, the Examiner has now required applicant to submit a second set of substitute Figs. 1, 10-12, under separate paper addressed to the Official Draftsperson. This second submission is being filed herewith.

Claims 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 21, 22, 23, 24 stand objected to for various grammar issues which the Examiner has recited in his paragraphs numbered 6-63. Each of the Examiner's remarks of his paragraphs 6-63 have been followed in amending these claims. A deviation has been made in amending claims 8-13. Claims 8-13 recite the structure shown in Figs. 8-10 and described in the specification at pages 16-19, and in other areas of the specification. In addition to the amendments suggested by the Examiner, claims 8-13 have also been amended herein to make their language consistent with the terminology recited in the specification pages 16-19.

Claims 1-24 stand rejected under 35 USC 112, second paragraph, as being indefinite. The Examiner has remarked that claims 1, 2, 4, 8, 11, 18, 22, and 24 contain terminology, which the Examiner considers indefinite (Examiner remarks, pp 19-22). These claims 1, 2, 4, 8, 11, 18, 22 and 24 have each been amended to delete or amend the terminology.

Claims 9, 10 are remarked upon as indefinite for the inclusion of the phrase "for example" (Examiner remarks, pp 22). These claims have been amended to delete this pharse.

Claims 17 and 23 are remarked upon as indefinite for the inclusion of the phrase "in

particular" (Examiner remarks, pp 22-23). These claims 17 and 23 have been amended to delete this phrase.

Claims 1-9, 14, 16, 17 and 19-23 stand rejected under 35 USC 103(a) as being obvious in view of Schwarte (WO 98/10255) when read with Erhardt (USPN 5,051,797) and Labmeth (USPN 4,826,312).

Schwarte is an International Application, PCT/DE97 01956, the drawings for which (Figs. 1014) were provided by the Examiner with the English Abstract and German specification. Attached hereto as Exhibit "A" is a photocopy of the Figs. 1/14 through 14/14 from PCT/DE/01956. No translation of the German specification was provided by the Examiner. Applicant has obtained a photocopy of a parallel application filed out of PCT/DE/01956, as Australian number AU 199743761 B2 (Patent No. 715284). Attached hereto is a photocopy thereof marked as Exhibit "B".

<u>Schwarte is relied upon for:</u>

1. apparatus for detecting the phase and amplitude of electromagnetic waves with two photosensitive modulation photogates paired in parallel (Fig.6: G_{am} and G_{bm}) being arranged substantially at equal spacing in a push-pull relationship (Fig. 7, 13 and p 5, lines 20-27)

2. accumulation gates (Fig. 6: G_a and G_b) arranged between the pairs of photogates (Fig.7) and connected to a reading-out device (Fig. 13, element 15)

3. a modulating device (Fig. 12 element 11, +Um(t) and -Um(t)) to increase or reduce potential of the modulation photogates

4. said accumulation gates being in the form of "reading-out diodes" (Fig.13, element 2 and n+ connected to Ga and Gb) to form a PMD-pixel (abstract, last sentence) being in a linear or matrix array (claim 22)

5. wherein said diode electrode is a reading out electrode (Fig.13)

6. wherein the width of said modulation gates (G_{am} and G_{bm}) being greater than the width of said accumulation gates (G_a and G_b) as shown in Fig.13

7. a covering by a contact of high conductivity and very low transparency of electromagnetic waves (Fig.13, electrode of Ga and Gb above the n+ material)

8. pixel elements (Fig.2) having a plurality of pairs of modulation gates (G_{am} and G_{bm}) and accumulation gates (G_a and G_b) as shown in Fig.14

9. wherein strip directions of said modulation gates (G_{am} and G_{bm}) and said accumulation gates (G_a and G_b) are perpendicular to each other as shown in Fig.14 and Fig.2

10. wherein PMD and CMOS pixels may be mixed for a depth image (page 17, col. 6-10) [sic: page 17, lines 6-10]

11. a 3D and 2D functionality together with a data-fusioning and interpolating device for a depth image (page 17, col 12-17 and 26-30) [sic: page 17, lines 12-17]

12. wherein an image is illuminated by a modulation function with the photogates in push-pull

13. half of the pixels are 90° phase-shifted in the case of sine modulation (Figs. 11 and 12)

<u>Erhardt is relied upon for:</u>

accumulation gates neither photosensitive nor shaded (Fig. 2, element 34 and col. 3, lines 21-30).

<u>Lambeth is relied upon for:</u>

strips for photogates (Fig.)

The Examiner's translation of Schwarte (WO 98/10255) is respectfully TRAVERSED, in part.

The Schwarte (WO 98/10255) device (hereinafter "1998 Schwarte structure"), implements an entirely different algorithm than the present invention, and thereby also shows structure that departs in its confirmation, operation and function from that disclosed in this application. One of ordinary skill would not consider trying to adapt the present structure of this invention to implement the 1998 Schwarte algorithm. Nor would one of ordinary skill attempt to use the 1998 Schwarte structure to implement the algorithm of the present invention.

<u>With respect to the 1998 Schwarte structure:</u>

Fig. 6 shows in Fig. 6(a) a view in cross-section of a pixel of a <u>second embodiment</u> using CCD-technology of a photonic mixing element according to the invention with a middle modulation photogate G_0 as well as the potential distributions under the modulation photogates and accumulation gates Fig. 6(b) for a positive modulation voltage $U_m(t)$ and Fig. 6(c) for a negative modulation voltage $U_m(t)$. **Australia patent 715284 (hereinafter "Australia") pages 22-23**.

Fig. 6 shows an embodiment (second embodiment) by way of example in which a middle gate Go is arranged between the modulation photogates Gam and Gbm, the middle gate preferably being at the bias voltag U_o and together with the modulation photogates G_{am} and G_{bm} forming three potential stages. What is desired is a potential gradient which is as uniform as possible, and that is achieved by increasing the number of stages from two to three or even more. In the photosensitive space charge zone the degree of definition or pronouncement of the stages decreases ... The arrangement also includes a shading 12 for the accumulation gates G_a and G_b so that they are lit by the light wave and additional charge carriers produced. **Australia pages 33-34**.

Fig. 7 shows in 7(a) a view in cross-section of a pixel of a third embodiment of a photonic mixing element according to the invention in 7(b) - 7(f) the potential distributions for the various phases, similarly to Fig. 1. **Australia page 23**. [compare 1(b) to 7(b) and 1(c) to 7(c) et al.]

Fig. 7 shows ... in comparison with that in Fig. 1, the two modulation photogates are respectively only separated by a common accumulation gate $G_{s,n}$, thereby achieving a higher degree of filling action... In this case the plarity of the push-pull modulation voltages or the sequence of $G_{am,n}$ and $G_{bm,n}$ changes from pixel to pixel. ... A disadvantage which can be tolerated in certain applications lies in the charge distribution also to the respectively adjacent pixels, which results in an apparent pixel size increase and a lower degree of positional resolution in the direction in question. ... Calculation of those interrelationships and influences shows that, in comparison with a 100% useful charge, upon evaluation of the charge differences, the central pixel considered acquire only 50% and the two adjoining pixels each acquire 25%. ... To illustrate the charge distribution, Fig. 7, similarly to Fig. 1, shows the various phases of potential distribution for CW- modulation. **Australia page 34**. ["CW-modulation" is continuous wave modulation].

Fig. 13 shows in Fig, 13(a) a view in cross-section of a pixel of a sixth embodiment of a photonic mixing element according to the invention with electonic pixel read-out and pre-processing system using CMOS-technology and in 13(b) and 13(c) the potential distribution similarly to Fig. 6 for two phases or polarityies of the modulation photogate voltage. **Australia page 23**.

... Fig. 13 shows a futher preferred embodiment of a pixel 1 which, in contrast to the above-discussed embodiments, is implemented not using CCD-technology but CMOS-technology with electronic pixel-wise reading-out and signal pre-processing system 15. In this case, the mode of operation of the modulation voltage-dependent drift of the charge carriers on the charge swing is the same as in the above-discussed embodiments. The only difference in the embodiment shown in Fig. 13 is the manner of implementing further processing in respect of the charges q_a and q_b which have drifted in the accumulation gates G_a and G_b. In the present (sixth) embodiment the accumulation gates G_a and G_b are in the form of blocked pn-diodes. The positively biased accumulation gates G_a and G_b are formed in n_+-doped electrodes on a preferably weakly doped p-Si-substrate 3 in Fig. 13. In ..."floating-diffusion" mode of operation or in the high-resistance voltage read-out mode, as in the case of using CCD-technology, the charges q_a and q_b are integrated on the capacitances of the accumulation gates G_a and G_b and are read out in a high-resistance mode in the form of voltage values... It is advantageously also possible to us a current read-out mode in which the photogenerated charge carriers are not integrated in the potential well but are continuously passed by way of output diffusion ... then integrated for example on a respective external capacitance. .. A reading-out circuit in the

current read-out mode which keeps the accumulation gate voltage virtually constant by virtue of amplifier feedback advantageously ensures that...the accumulated charges q_a and q_b does not result in a reaction on or indeed overflowing of the potential well. **Australia page 36**.

Fig. 12 is a diagrammatic view of an apparatus according to the inventio for determining the phase and amplitude information of a light wave, for exampe for PN-modulation or rectangular modulation. **Australia page 23**.

An embodiment ... for surveying or measuring optically passive 3D-objects is shown in Fig. 12. Similarly to the embodiment involving harmonic modulation in Fig. 11 the apparatus accofing to the invention has a suitable lighting device which lights the 3D-objects 6 with light which is PN (Pseudo-Noise)-modulated in intensity and the reflected and received light is subjected to the correlation procedure ... Fig 5a shows the modulation signal $U_m(t)$, in regard to the example of a rectangular 15 bit PN-sequence. The result of the correlation by the photonic mising element is the averaged drift currents...shown in fig. 5b...the push-pull modulation photogate voltages which are applied to the modulation photogates G_{cm} and G_{dm} and which are superimposed on the bias voltaghe Uo are preferably delayed T_B with respect to the push-pull modulation photogate voltages applied to the modulation photogates Ga and Gb, that is to say $U_{cm}(t) = U_o + U_m\ (t-T_b)$ and $U_{dm}(t) = U_o - U_m\ (t-T_B)$, which results in highly advantageous amplitude and transit time measurments. **Australia page 31**.

The difference shows a steep linear configuration which permits the transit time to be determined with a high degree of resolution. The following (equation) applies for the example which is idealised here:

$$\tau = T_D = [\ T_B/2]\ - [\ (\Delta\ i_{ab} - \Delta i_{cd})\ /\ (\Delta i_{ab} - \Delta\ i_{cd})\ \ ] + [\ T_B/2\ ] \ldots$$

(Brackets and parenthesis are added for clarity)

The block diagram of a corresponding measuring apparatus for the optical measurement of 3D-objects with PN-modulation based on the proposed correlation photodectector array is characterised by a structure of particular simplicity as can be seen from Fig 12. **Australia page 32**.

Applicant leaves the reading of the remainder of the Australian parallel patent to the Examiner. However, it is clear that the structure shown and described in the Schwarte reference relied upon by the Examiner is markedly different from what the Examiner believes it to be. The structure of the Shwarte reference in its composition, its operation and the algorithm being implemented is markedly different from the present invention. Thereby, the Schwarte reference cannot be relied upon to obviate the claims 1-26 as amended herein.

The Examiner's attention is directed to Schwarte Figs. 3 and 4 which shows his analog frequency modulation and detection. This is supported by the disclosure and the cosine equations of pages 25, and 28, and the integration equation of page 28. **Australia disclosure**.

It is requested that the subject application be re-examined as to the amended claims 1-24 and new claims 25 and 26 presented herein. It is urged that these claims now distinguish the present invention over the cited art and therefore this application is now in condition for allowance.

Respecttfully submitted,
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